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SITE: Sixty One Industrial Park
BREAK: 2.8
OTHER: _____

United Technologies Automotive

Detroit, Michigan

**Removal Action under the
Administrative Order on
Consent (AOC) Final Report**

**Highway 61 Industrial Site
Memphis, Tennessee**

ENSR Consulting and Engineering

February 1997

Document Number 6916147.R01



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1.0 INTRODUCTION

This document serves as the Final Report for the Removal Action activities conducted at Sixty-One Industrial Park Site in Memphis, Tennessee under the Administrative Order on Consent (AOC) between UTA and EPA dated April 10, 1996. This report includes a description of the site activities, the analytical results and data validation from all sampling events, and the nonhazardous waste manifests/weigh tickets for the treated sludge disposed of off-site.

1.1 Report Organization

The Final Report is organized into the following sections:

Section 1.0 Introduction - Describes the organization of the Final Report and contains the certification statement by UTA as required by Section V.2.6 of the AOC.

Section 2.0 Setting - Presents a site description and history, and the regulatory background of the project to date.

Section 3.0 Activities Conducted Under the UAO Briefly summarizes removal action activities conducted by UTA/ENSR under the Unilateral Administrative Order (UAO dated January 26, 1995) which led to the work conducted under the AOC.

Section 4.0 Sludge Treatment and Disposal Conducted Under the AOC - Summarizes the lagoon sludge excavation and treatment activities conducted by ENSR as part of the Removal Action under the AOC, and provides the analytical results of the treated sludge verification samples.

Section 5.0 Wastewater Discharge to the POTW - Summarizes the wastewater discharge events conducted under the AOC and provides the analytical results of the samples collected to meet the POTW requirements.

Section 6.0 Removal Confirmation Sampling - Summarizes the sampling events conducted to confirm removal of the impacted sludge from the former lagoons and provides the analytical results of the confirmation samples.

Section 7.0 Conclusion - Summarizes and concludes the events and the outcome of the AOC.

Section 8.0 Cost - Provides a good faith estimate of total costs incurred in complying with the AOC.

1.2 Certification

In accordance with Section V.2.6 of the AOC, UTA makes the following certification regarding the preparation of this report.

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Francis J. Macielak, Jr.
Director, Environment, Health & Safety

2.0 SETTING

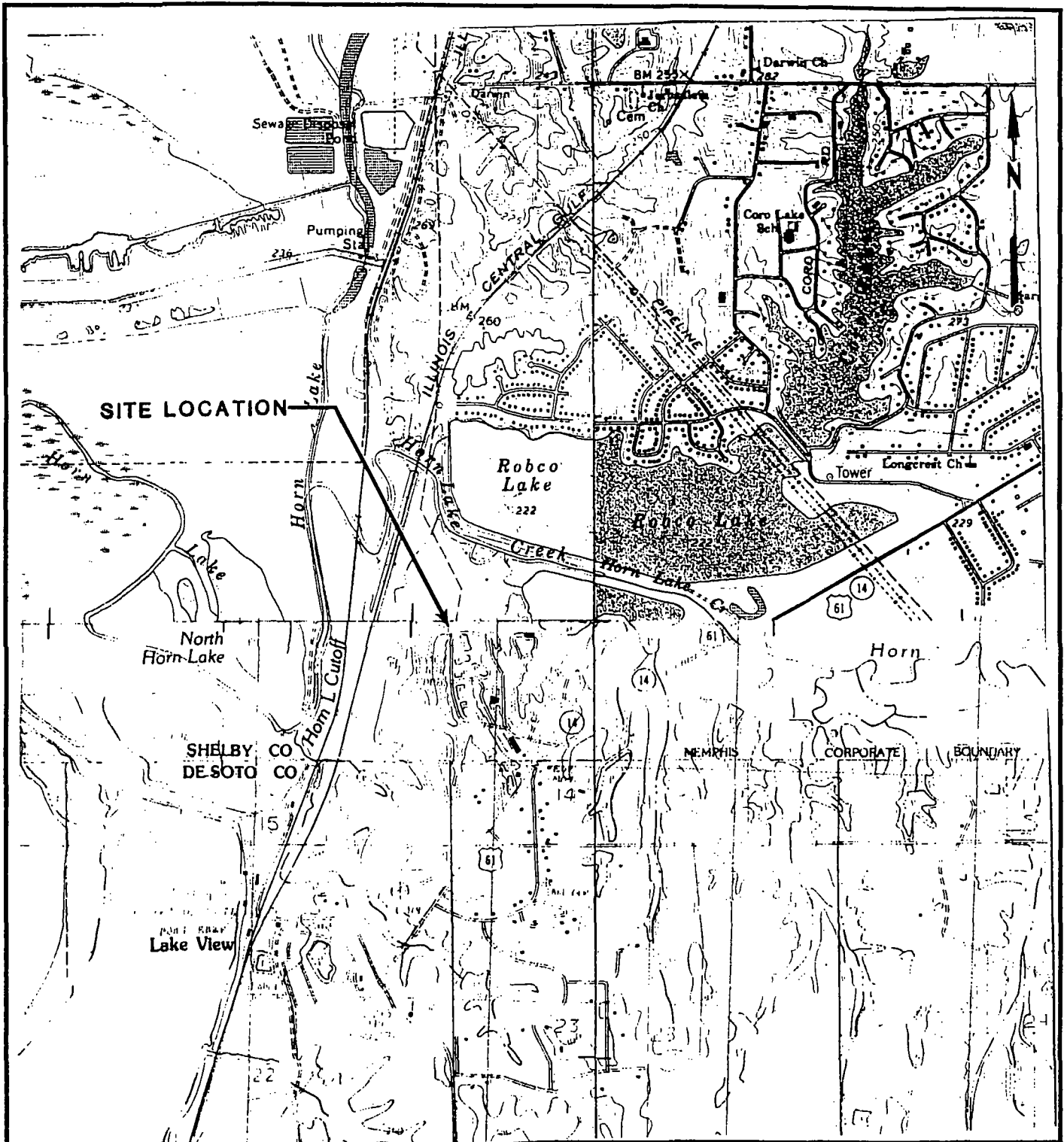
2.1 Site Description and Background

Highway 61 Industrial Park, Memphis, Tennessee, hereafter referred to as "the site", is located on approximately 97 acres near the Tennessee/Mississippi state line in southwest Shelby County, Tennessee. Figure 1-1 is a vicinity map showing the site's location. The site contains seven lagoons and numerous buildings; salvage material is located throughout the site. Approximately 3.5 to 3.7 acres of the site consist of lagoons. At present, site access is controlled by a 6-foot cyclone fence around the perimeter of the developed section.

Pace-Caribe, Inc., (Pace) operated a pyrotechnic and ordnance production facility on the Site from the early 1960s through 1967, manufacturing flares, smoke signals and bombs, illuminating signals, ignition and detonation devices, and other ordnance for the military during the Vietnam War. Pace also conducted metal plating operations on the Site. The metal plating system included the series of lagoons which were allegedly used for oxidation purposes.

Ambac Industries, Inc. purchased the property from Pace in 1968, and Pace continued as a division of Ambac in pyrotechnic and ordnance production on the Site, as well as metal plating operations, until 1973.

On April 10, 1973, Mr. Bennie Lazarov, as nominee for 61 Industrial Park, Ltd., purchased the Site from Ambac Industries. In the April 10, 1973 sales agreement, Ambac Industries, Inc. reserved the right to complete plating operations, using buildings, machines and equipment, warehouses, a water pumping station and plating water treatment facilities for 30 days after the date of the agreement. Ambac Industries, Inc., exercised these rights, continuing operations through May 9, 1973. The plating equipment and associated plating chemicals were then sold to 61 Industrial Park, Ltd. as part of the Sales Agreement. After sale to 61 Industrial Park, Ltd., the site was used to store salvage material. Additionally, the property was leased to several businesses between 1973 and present. The site is currently owned and operated by Mr. Buddy Lazarov and is used for storing salvage material.


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FIGURE 1-1 SITE VICINITY MAP

 Highway 61 Industrial Site
 Memphis, Tennessee

Source: Draft Removal Action Work Plan, March 27, 1995

DRAWN: EnSafe	DATE: February 19, 1997	PROJECT NO.: 6916-147-100	REV: 0
FILE NO.:	CHECKED: ENSR, 1997		

2.2 Regulatory Background

In November 1993, EPA Region IV conducted a preliminary investigation of the site to ascertain whether or not a potential threat to the environment and human health existed because of past practices at the facility. EPA's assessment identified metal and organic contamination, explosives, slag piles, waste batteries, and waste-containing drums in addition to seven lagoons allegedly used for oxidation purposes and containing contaminated sludge. EPA directed that these items be removed from the Site and disposed of (UAO dated January 26, 1995).

The portion of the work performed by UTA as described in the Order included:

- removal and disposal of the contaminated sludges and soils associated with on-site lagoons exceeding cleanup levels; and
- confirmatory sampling in and adjacent to the excavation areas and, to the extent associated contamination exceeded cleanup goals, removal and disposal of such contamination until confirmatory sampling demonstrated compliance with cleanup levels.

EPA was in agreement that the removal action could include on-site treatment, providing the cleanup levels were achieved.

Table 1-1 presents the preliminary cleanup levels established by EPA.

TABLE 2-1
Soil Removal Cleanup Levels

Parameter	Cleanup Level, parts per million (ppm)
Total Petroleum Hydrocarbons (TPH)	100
Cadmium (total)	60
Chromium (total)	400
Chromium VI	205
Lead (total)	500

3.0 ACTIVITIES CONDUCTED UNDER THE UAO

Activities conducted by UTA/ENSR and the other Potentially Responsible Parties (PRPs) under the UAO are detailed in the UAO Final Report, which will be submitted to EPA by the UAO Project Coordinator, EnSafe, within 90 days of the UAO deadline. Those activities which led to the work conducted under the AOC are briefly summarized in this section.

3.1 Lagoon Investigation Activities

As part of the Removal Action, ENSR conducted an investigation of the lagoons, which consisted of the following activities:

- Sampling and analysis of sludges and underlying soils in each of the lagoons.
- Sampling and analysis of the surface water in each of the lagoons.
- Installation of five groundwater monitoring wells and sampling and analysis of the groundwater from each well.
- Sampling and analysis of sediments from locations downstream of the lagoon surface water discharge.

The lagoon investigation activities conducted by ENSR and the analytical results of the investigation are detailed in the Removal Action Plan submitted to EPA and the State of Tennessee in June 1995 (ENSR Document No. 6916-133-600).

Based on the analytical data from the sludge characterization, the following constituents of concern were identified:

- cadmium
- chromium (trivalent)
- TPH

Analytical data from the groundwater sampling indicated that the contaminated sludges and soils had not impacted groundwater quality.

3.2 Treatment Activities

Once the lagoon water, sludges, and underlying soils were characterized, ENSR prepared a Streamlined Feasibility Evaluation to determine the optimum removal action alternative. The evaluation was submitted to EPA as part of the June 1995 Removal Action Plan. The removal action alternative selected consisted of on-site solidification/stabilization of the lagoon sludge, followed either by on-site containment or off-site disposal at an approved landfill.

ENSR conducted a bench-scale treatability study in September of 1995 to determine the optimum recipe for achieving sludge stabilization and solidification. Results of the study indicated that a 10% mix of lime kiln dust (LKD) would meet land disposal restriction (LDRs). Due to the difficulties in achieving thorough mixing of a 10% admixture, ENSR and UTA decided to use a 20% mix of LKD. A pilot study was conducted, and the results supported the findings of the bench-scale test, indicating that a mixture of 20% LKD alone would immobilize the constituents of concern to meet LDR criteria, and that a mixture of 20% LKD along with 5% portland cement would also meet strength criteria for on-site disposal with a clay cap.

Stabilization agents were transported to the site and stockpiled in each lagoon; the specified volumes of reagents were dispersed throughout the lagoons using tracked excavators. After application of the 20% LKD (weight:weight basis), the sludge and soils were mixed (the process hereafter referred to as preconditioning) using a trackhoe. Mixing continued until the blended materials appeared homogeneous.

Following preconditioning of each lagoon, sludge from Lagoons 1, 2, 3, and 5 were consolidated into Lagoons 4 and 6.

Confirmation sampling of floors and sidewalls of the excavated lagoons (Lagoons 1, 2, 3, and 5) was conducted in accordance with the June 1995 RAP. Confirmation samples along the floor of the excavated lagoons were collected at the nodes of a 70' X 70' grid. Samples along the sidewalls were collected from mid-depth every 50' around the lagoon periphery. Confirmation samples were analyzed for total cadmium, total chromium and TPH. Final confirmation sample results indicated that all former lagoons (other than 4 and 6) were excavated to below clean-up levels. Analytical results and data from all confirmation samples collected as part of work conducted under the UAO are provided in the UAO Final Report.

3.3 Submittal of Delisting Petition

During the course of conducting preconditioning activities, it was confirmed by EPA that the lagoon sludge was classified as a listed hazardous waste because a portion may have been generated as part of electroplating activities. (Under 40 CFR 261, Subpart D, wastewater treatment sludges from electroplating operations are classified as EPA Hazardous Waste Number F006.) Therefore, unless the sludge was "delisted", it would have to either be treated and contained on-site (as a CERCLA area of contamination) or disposed of off-site as a hazardous waste.

In October of 1995, ENSR prepared and submitted a petition to exclude or "delist" the stabilized sludge from the lists of hazardous wastes in 40 CFR Part 261, Subpart D, in accordance with the procedures set forth in 40 CFR §260.20 and §260.22. The basis for the delisting request was that the constituents for which the sludge was rendered hazardous were rendered immobile by stabilization.

The delisting petition was submitted to the project On-Scene Coordinator (OSC), Ms. Dora Ann Johnson, to forward to the appropriate regulatory personnel. In January of 1996, ENSR covered the preconditioned sludge with plastic liners for temporary storage in Lagoons 4 and 6 and demobilized from the site pending EPA review of the petition.

Review of the petition by EPA was delayed by the shifting of regulatory authority which occurred at the time of the petition submittal. On November 20, 1995, ENSR called the Tennessee Department of Environment and Conservation (TDEC), Division of Solid Waste (Nashville) to inquire about the status of the petition. The TDEC (Mr. Jerry Ingram) informed ENSR in this telephone conversation that the authority to delist a waste in the state of Tennessee currently belonged to EPA (as opposed to the State). On November 23, 1995, EPA, Washington D.C. (Mr. Chichang Chen), confirmed receipt of UTA's petition forwarded by Ms. Johnson. However, Mr. Chen informed ENSR that as of October 1995, EPA headquarters reverted delisting authority back to EPA Regions, and therefore (EPA) headquarters would be sending the petition back to (EPA) Region IV for review.

In January 1996, the EPA RCRA branch, Region IV, (Ms. Judy Sophianopoulos) confirmed receipt of the petition, and made subsequent requests for minor additional data and clarifications. ENSR submitted the requested information and clarifications in January and February, 1996, and on February 21, 1996, pursuant to Ms. Sophianopoulos' request, ENSR submitted a copy of the petition to the TDEC (Mr. Jerry Ingram).

4.0 SLUDGE TREATMENT AND DISPOSAL CONDUCTED UNDER THE AOC

In April of 1996, ENSR prepared and submitted to EPA a Revision to the Removal Action Plan (RAP) Supplement, which provided the scope of work for completion of the removal action under the April 10, 1996 AOC between UTA and EPA. The plan provided for final stabilization and off-site disposal of the sludge stockpiled in Lagoons 4 and 6. The plan provided, as a contingency, on-site containment in Lagoon 6 should the sludge not be delisted or not meet the final delisting criteria.

4.1 Delisting Rule

On April 3, 1996, EPA published the proposed rule granting a "one-time" up front exclusion for the stabilized sludge, contingent upon the treated sludge meeting delisting criteria published as part of the proposed rule (61 *FR* 14708, April 3, 1996). Upon receiving comments, EPA finalized the rule in July of 1996 (61 *FR* 37399, July 18, 1996), (with subsequent corrections in August and October, 1996). The delisting criteria were modified slightly (i.e., became more stringent) during the course of operations due to an increased volume of sludge over what was originally anticipated.

4.1.1 Delisting Criteria

The delisting criteria set forth in the final delisting rule were calculated by multiplying a health-based level for each constituent of concern by a dilution attenuation factor (DAF) of 96 for a one-time disposal of an estimated volume of 20,500 cubic yards of petitioned waste.

In October 1996, ENSR notified EPA that the volume of impacted sludge had been underestimated, and provided an initial revised estimate of 30,000 cubic yards, followed by a second volume estimate of 35,000 cubic yards. On October 25, 1996, EPA published a correction to the rule, with recalculated delisting levels using a DAF of 84 for a volume of 35,000 cubic yards. Corrected delisting criteria were effective retroactively, beginning July 18, 1996.

In December 1996, ENSR notified EPA of the final volume of treated and disposed sludge as verified by weigh tickets and manifests to be 39,400 cubic yards. On January 31, 1996, EPA published a correction to the rule, with recalculated delisting levels using a DAF of 79 for a volume of 40,000 cubic yards. Final corrected delisting criteria were effective retroactively, beginning July 18, 1996.

Table 4-1 presents the original and final delisting criteria. Leachable concentrations of the listed constituents were not to exceed the levels shown in the table.

TABLE 4-1
Delisting Criteria for Treated Sludge

Constituent	Maximum Concentration in the Leachate, mg/L		
	7/18/96 Final Rule	10/25/96 Correction	1/31/96 Correction
Cadmium	0.48	0.42	0.40
Chromium	5.0 ¹	5.0	5.0
Lead	1.4	1.26	1.18
Nickel	9.6	8.4	7.9
Cyanide ²	19.2	16.8	15.8
<p>1 - The delisting level for chromium in leachate was originally published as 9.6 mg/L, but was corrected by EPA (published in August 1996) to be consistent with the criterion for the hazardous characteristic of toxicity.</p> <p>2 - Cyanide extraction must be conducted using deionized water.</p>			

4.2 Verification Testing Requirements

The delisting rule set forth verification testing requirements for demonstrating that the delisting criteria were met. Verification testing procedures had also been outlined in the approved April 1996 Revision to the RAP Supplement, hereafter referred to as the RAP Supplement. During the first week of operations, ENSR worked with the OSC (Ms. Dora Ann Johnson) to revise the RAP Supplement to be consistent with the delisting requirements while still satisfying the objectives of the removal action.

The delisting rule specified that a minimum of four representative composite samples be collected from every batch, for eight sequential batches of stabilized sludge generated during full-scale operation. A batch was defined as the stabilized sludge generated during one run of the stabilization process. If the initial verification testing proved successful (i.e., the delisting levels were achieved), a minimum of one composite sample per batch was to be collected from at least 5% of the remaining batches.

In order to comply with the RAP Supplement, which specified a minimum of one representative composite sample for every 1,000-cubic yards of treated sludge, the sludge was treated and stockpiled for testing in 1,000-cubic yard batches. Four composite samples were collected from the first eight batches, and one composite sample was collected from each subsequent batch. In accordance with the RAP Supplement, all composite samples collected were comprised of equal (approximate) amounts of treated sludge from a minimum of 5 different locations around the pile.

4.3 Sludge Treatment and Verification Sampling

ENSR conducted all sludge treatment operations and verification sampling under the oversight of the OSC and/or an OSC representative (a START Contractor). In addition, ENSR operated under the conditions set forth in the delisting rule, which included reporting stabilization activities and initial results to the EPA RCRA Compliance Section, Region IV, Athens, Georgia.

4.3.1 Initial Treatment and Verification Sampling (Batches 1 - 8)

In August 1996, ENSR remobilized to the site to begin final stabilization and verification testing activities. Final stabilization consisted of adding additional LKD (approximate 5% additions) to 12 to 18-inch lifts of preconditioned sludge and mixing with a pulvimixer. Upon mixing with the pulvimixer, each treated lift was pushed into a 1,000 cubic yard stockpile for verification sampling. Each stockpiled lift was designated as a Batch, with a number assigned to indicate the sequential order in which it was treated.

Four composite samples were collected from Batches 1 - 8, as specified in the published delisting rule and RAP Supplement. For each of the first eight batches, one of the four (composite) verification samples was split with the EPA Environmental Services Division (EPA-ESD), Region IV, for analysis by their Athens laboratory. Mr. Tim Hampton of the EPA-ESD, Region IV, was present on-site on August 15, 1996 to observe and assist in the collection of the split sample. Mr. Hampton left the site in possession of one split sample collected jointly with ENSR (from Batch 1); the remainder of the splits were collected for and submitted to the EPA-ESD laboratory by ENSR (under OSC oversight).

Initial results from the first two batches indicated that the treated sludge contained leachable cadmium at concentrations slightly higher than the established delisting levels. The ENSR field crew suspected that the failure to meet criteria may have resulted from (1) inadvertent scraping of untreated sludge from immediately below the treated lifts (when pushing the treated lifts into stockpiles) and/or (2) inadequate mixing (thus not maximizing exposure of the sludge matrix surface area to LKD). For each of the batches, ENSR spread the stockpile out, mixed in

additional LKD, and pushed up the remixed batch into a new stockpile. Concurrently, ENSR treated a third lift, Batch 3, (1) using a higher dosage of LKD (2) passing over the lift with the pulvimixer twice and (3) taking extra precautions not to scrape beyond the depth of the treated lift. ENSR also treated a fourth lift, Batch 4, using the same amount of LKD as that used initially on Batches 1 and 2, but mixing with the pulvimixer twice and taking extra precautions to prevent inadvertent scraping into the untreated sludge.

The remixed Batches 1 and 2 were sampled using the initial sampling methodology, including the collection and submittal of split composite samples for EPA-ESD. Results from the remixed Batches 1 and 2 indicated that the retreated batches met delisting criteria.

Results from Batches 3 and 4 indicated that both of these batches met delisting criteria, suggesting that the initial failures of Batch 1 and 2 were due either to inadequate mixing or to an inadvertent inclusion of untreated sludge, and not the result of insufficient amounts of LKD.

All subsequent batches (after Batch 4) were mixed with the pulvimixer twice prior to stockpiling. Also, to prevent inclusion of untreated sludge into a treated stockpile, 1 - 2 inches of each treated lift was left remaining on the ground, and was thus mixed in as part of the next lift.

Table 4-2 presents the results for each of the first eight batches of treated sludge. The shaded values indicate the results which exceeded the delisting levels (Batches 1 and 2). Table 4-3 presents the results of the remixed Batches 1 and 2. Analytical data are contained in Appendix A to this report.

TABLE 4-2
Treated Sludge Verification Sample Results, Batches 1 - 8

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
Batch 1						
BATV1CP101	08/15/96	0.62	0.50 U	0.50 U	0.50 U	0.010 U
BATV1CP201		0.80	0.50 U	0.50 U	0.50 U	0.010 U
BATV1CP301		0.32	0.50 U	0.50 U	0.50 U	0.010 U
BATV1CP401		0.80	0.50 U	0.50 U	0.50 U	0.010 U
Batch 2						
BATV2CP101	08/19/96	0.80	0.50 U	0.50 U	0.50 U	0.010 U
BATV2CP201		0.68	0.50 U	0.50 U	0.50 U	0.010 U
BATV2CP301		1.08	0.50 U	0.50 U	0.50 U	0.010 U
BATV2CP401		1.08	0.50 U	0.50 U	0.50 U	0.010 U
Batch 3						
BATV3CP112	08/19/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV3CP212		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV3CP312		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV3CP412		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
Batch 4						
BATV4CP101	08/20/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV4CP201		0.10	0.50 U	0.50 U	0.50 U	0.010 U
BATV4CP301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV4CP401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U

TABLE 4-2
Treated Sludge Verification Sample Results, Batches 1 - 8 (Contin. . .)

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
Batch 5						
BATV5CP101	08/21/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV5CP201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV5CP301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV5CP401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
Batch 6						
BATV6CP101	08/26/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV6CP201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV6CP301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV6CP401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
Batch 7						
BATV7CP101	08/30/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV7CP201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV7CP301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV7CP401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
Batch 8						
BATV8CP101	08/30/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV8CP201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV8CP301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV8CP401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
* - Since Batches 1 and 2 did not initially meet the delisting criteria, they were remixed. Results are presented in Table 4-3.						
U - Not detected; preceding number is report limit.						

TABLE 4-3
Remixed Sludge Verification Sample Results (Batches 1 and 2)

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
Batch 1, Remixed						
BATV1C2101	08/20/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV1C2201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV1C2301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV1C2401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
Batch 2, Remixed						
BATV2C2101	08/26/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV2C2201		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV2C2301		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BATV2C2401		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
U - Not detected; preceding number is report limit.						

4.3.2 Completion of Sludge Treatment (Batches 9 - 36)

Due to the proximity of work to the natural gas pipeline in Lagoon 4, ENSR excavated the preconditioned sludge from above and west of the pipeline and spread it on the east end of Lagoon 4 and the north end of Lagoon 6 for stabilization. As stabilization activities proceeded into lower lifts close to Lagoon 4 bottom, the sludge became much wetter. In order to continue stabilization, ENSR excavated the sludge remaining in the east end of Lagoon 4 and spread it on the north end of Lagoon 6 for stabilization.

Once verification testing indicated that eight consecutive batches of sludge were treated successfully, verification testing for all subsequent batches consisted of one representative composite sample per batch (1 per 1,000 cubic yards of treated sludge). Verification sample results for all batches indicated that the treated sludge met delisting criteria. Table 4-4 presents the results for all verification samples collected (Batches 9 - 36). Analytical data are contained in Appendix A.

A slight discrepancy between the volume of sludge estimated in the field (36,000 cubic yards) versus the final sludge volume calculated by the landfill (39,400 cubic yards) resulted from the fact that batches in the field were measured in the form of lifts of stockpiled sludge. The final volume calculated by the landfill (BFI) was based on densities measured by BFI as the stabilized sludge was received. The sludge in the stockpiled lift was more dense than that measured at the landfill due to the handling and loading (fluffing) of the stabilized sludge after field measurements were made. Since verification samples were collected as each batch was treated, the total number of samples (36) corresponds to the 36,000 cubic yard estimate.

TABLE 4-4
Treated Sludge Verification Samples, Batches 9- 36

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
BATV9CP100	09/06/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV10CP100	09/09/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV11CP100	09/11/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV12CP100	09/19/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV13CP100	09/20/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV14CP100	09/21/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV15CP100	09/24/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV16CP100	09/26/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV17CP100	09/30/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV18CP100	10/20/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV19CP100	10/04/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV20CP100		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV21CP100	10/07/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV22CP100	10/09/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV23CP100		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV24CP100	10/11/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U

TABLE 4-4
Treated Sludge Verification Samples, Batches 9- 36 (Contin. . .)

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
BAV25CP100	10/16/96	0.30	0.50 U	0.50 U	0.50 U	0.010 U
BAV26CP100	10/18/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV27CP100	10/23/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV28CP100	11/04/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV29CP100	11/06/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV30CP100	11/14/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV31CP100	11/18/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV32CP100	11/19/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV33CP100	11/21/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV34CP100	11/22/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV35CP100	11/29/96	0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
BAV36CP100		0.10 U	0.50 U	0.50 U	0.50 U	0.010 U
U - Not detected; preceding number is report limit.						

4.3.3 Quality Assurance/Quality Control Samples Collected by EPA - OSC

On September 26, 1996, as an additional QA/QC check by the OSC, the EPA START Contractor collected three samples from a stockpile of treated sludge (Batch 14). [ENSR had previously collected a verification sample from Batch 14, and results indicated that the batch met delisting criteria (See Table 4-4)]. ENSR field personnel noted in their field notes that the START Contractor did not collect the samples in accordance with Region IV Standard Operating Procedures (SOPs). ENSR collected three samples (not split) from the same vicinities as the START Contractor and submitted the samples to Specialized Assays. Results from ENSR's samples submitted to Specialized Assays indicated nondetect concentrations of TCLP cadmium, chromium, lead, nickel, and cyanide.

The EPA OSC informed ENSR that results from the samples collected by their START contractor (submitted to Kiber Environmental Services) failed criteria, with TCLP-cadmium concentrations ranging from 3 ppm to 7 ppm. These results resembled those obtained for the preconditioned (but not final-treated) material, suggesting that the EPA START contractor may have inadvertently collected samples from untreated material.

ENSR informed the OSC that the START contractor had not collected the samples using EPA protocol, and questioned whether the contractor had actually collected samples from the treated sludge. As a result of this discussion, the OSC approved a new sampling event, in which ENSR would collect samples from the same batch of sludge (under the oversight of the START contractor) and split the samples with EPA.

On Wednesday, October 2, 1996, ENSR collected three samples from the stockpile of treated sludge which was treated as Batch 14. In an effort to duplicate the sampling event conducted by the EPA START contractor on September 26, ENSR collected one sample from each of the purported locations from the pile (east side, south side, and bottom). ENSR collected sample material from each of the discrete locations and split the material into three different samples, one for submittal to Specialized Assays, one for submittal to Savannah Laboratories (an independent laboratory selected by ENSR), and one to be relinquished to the START contractor (for submittal to Kiber Environmental Services). Samples submitted to Specialized Assays and to Savannah Laboratories were analyzed for TCLP cadmium, chromium, lead, nickel, and cyanide. The samples submitted to Kiber (for EPA) were analyzed for TCLP cadmium and chromium only.

Table 4-5 presents the results of the samples submitted by ENSR to Specialized Assays and Savannah Laboratories.

TABLE 4-5
QA/QC Samples Split with EPA
(collected from stockpiled Batch 14)

Sample Designation	Date Collected	TCLP Concentration, mg/L				
		Cd	Cr	Pb	Ni	CN
Specialized Assays						
BAV14C2100	10/02/96	0.50 U	0.50 U	0.50 U	0.010 U	0.010 U
BAV14C2200		0.50 U	0.50 U	0.50 U	0.010 U	0.010 U
BAV14C2300		0.80	0.50 U	0.50 U	0.010 U	0.010 U
Savannah Laboratories						
BAV14C2100	10/02/96	0.10 U	2.0 U	2.0 U	0.20 U	0.010 U
BAV14C2200		0.10 U	2.0 U	2.0 U	0.20 U	0.010 U
BAV14C2300		0.10 U	0.20 U	0.20 U	0.20 U	0.010 U
U - Not detected; preceding number is report limit.						

Results from the samples submitted to Specialized Assays indicated nondetect TCLP concentrations of all constituents analyzed for two of the three samples, and 0.8 mg/L TCLP cadmium in the third sample (with nondetect TCLP concentrations of the other constituents). Results from the samples submitted to Savannah Laboratories indicated nondetect TCLP concentrations for all constituents analyzed for all three samples. Results from the samples submitted by EPA to Kiber indicated TCLP concentrations of cadmium ranging from 5.3 ppm to 5.6 ppm, and results for TCLP chromium ranging from 3.3 to 3.4 ppm.

ENSR discussed the discrepancy of results with Savannah Laboratories, the independent laboratory selected by ENSR for auditing purposes. Mr. Jessie Smith, the Lab Manager for Savannah Laboratories, indicated that the high concentrations reported by Kiber appeared to be the result of interference caused by the high calcium content of the material (i.e., the lime kiln dust mixture). Mr. Smith indicated that failure to account for the high calcium content would result in highly skewed results which could be of the same magnitude as the results provided by Kiber.

ENSR summarized the coinciding results of Specialized Assays and Savannah Laboratories in a memo to EPA, and stated ENSR's position that the treated sludge had previously met and continued to meet delisting criteria. Although TCLP cadmium was detected in one of the samples at a slightly higher concentration than the delisting criterion, ENSR did not believe that the pile was out of compliance since the result came from a grab sample (i.e., not a composite collected in accordance with the delisting requirements as well as the RAP Supplement), and also since the split of the same sample was reported as nondetect by Savannah Laboratories.

In response to ENSR's memo and analytical data, EPA requested that ENSR direct Specialized Assays and Savannah Laboratories to send all pertinent raw data and laboratory documentation to EPA-ESD in Athens, Georgia, for their review.

4.4 Disposal of Treated Sludge

Upon publication of the final rule delisting the stabilized sludge, ENSR applied to the State of Tennessee (Memphis field office and the Nashville main office) for approval to dispose of the delisted sludge as a special waste at the BFI South Shelby Landfill (Subtitle D landfill). ENSR had intended to load and transport treated sludge for disposal concurrently with treatment operations (in accordance with the RAP Supplement).

Upon review of ENSR's application, the TDEC discovered that the delisting petition had not been reviewed and approved by the State of Tennessee. The TDEC informed ENSR that although EPA had delisting authority, the State has an independent mandatory delisting process (which should have been conducted concurrently with the EPA review process). TDEC indicated that they would require up to 30 days to go through a state delisting process.

During the State delisting process, ENSR continued to treat batches of sludge, but operations were slowed down substantially due to the continual need to create space for new treated stockpiles and also to arrange each pile such that the next lift of sludge could be accessed for treatment. In a letter dated August 30, 1996, ENSR/UTA requested that EPA extend the AOC deadline to accommodate the TDEC delisting. EPA granted this extension in a letter dated September 12, 1996.

The TDEC Memphis office (Mr. Rodney Lumpkins and Mr. Mark Thomas) mobilized to the Site on August 20, 1996 and collected a split composite sample with ENSR from the remixed Batch 1 sludge for analysis at their State laboratory. Results obtained by the TDEC supported ENSR's results which indicated that the sludge met delisting criteria. (The TDEC also analyzed their sample for other TCLP metals, volatiles, semivolatiles, TPH, and pesticides/PCBs, and were satisfied that the sludge did not contain contaminants other than those for which it was listed).

The TDEC published a proposed rule to delist the sludge, and after a mandatory public comment period, published the final rule to delist the sludge on September 10, 1996 (with subsequent amendments in October 1996), enabling ENSR to begin loading treated sludge for transportation and disposal. In October 1996 and January 1997, ENSR notified the TDEC of increased sludge volumes over what was anticipated. The TDEC amended the state delisting rule, and the amended delisting levels concurred with the delisting levels published in the federal rule correction.

ENSR began loading, transportation and disposal of stabilized sludge which met delisting criteria in September 1996 and continued through December 1996. ENSR loaded for transport and disposal a total of approximately 39,900 cubic yards, which is based on a weight of 47,052 tons of treated sludge, with a density of 1.18 tons per cubic yard. All treated sludge was disposed of at the BFI South Shelby Landfill, in accordance with the Supplemental RAP. Nonhazardous waste manifests and weigh tickets are included in Appendix B.

5.0 WASTEWATER DISCHARGE TO THE POTW

During the work conducted under the AOC, the former Lagoon 5 continued to be used as a stormwater retention pond, collecting run-off which contacted preconditioned sludge for discharge to the POTW. Since the AOC (April 1996), ENSR sampled, obtained POTW approval, and discharged two batches of pond water, totaling approximately 2.96 million gallons.

Samples were collected in accordance with requirements set forth by the POTW (letter dated November 3, 1995 and November 9, 1995 telephone conversation). For each event, ENSR collected three samples from different areas around the pond near the surface and one sample from around the center of the pond, near the bottom. After the July 1996 event, ENSR obtained approval from EPA and the POTW (letters dated September 16, 1996 and October 7, 1996, respectively) to drop total toxic organics (TTOs) from the list of required parameters since TTOs had not been detected at significant concentrations in past events.

Tables 5-1 and 5-2 present the results of the discharge sampling events. Table 5-3 presents the results of the final sampling event conducted prior to site demobilization, demonstrating that the accumulated pondwater was not impacted (this water was not discharged to the POTW). Laboratory data sheets for these sampling events are included in Appendix A.

TABLE 5-1
Analytical Results from Wastewater Discharge Samples
6/21/96 Sampling/Discharge Event

Analyte	Concentration, mg/L			
	Sample Designation			
	LAG-1	LAG-2	LAG-3	LAG-CTR
Cadmium	0.0010 U	0.0010 U	0.0010 U	0.0060
Chromium	0.005 U	0.005 U	0.005 U	0.009
Copper	0.010 U	0.010 U	0.010 U	0.112
Lead	0.003 U	0.003 U	0.003 U	0.067
Nickel	0.010 U	0.010 U	0.010 U	0.062
Silver	0.0050 U	0.0050 U	0.0050 U	0.0050 U

TABLE 5-1
Analytical Results from Wastewater Discharge Samples
6/21/96 Sampling Discharge Event (Contin. . .)

Analyte	Concentration, mg/L			
	Sample Designation			
	LAG-1	LAG-2	LAG-3	LAG-CTR
Zinc	0.0200 U	0.0200 U	0.0200 U	0.1640
Total Cyanide	0.010 U	0.024	0.010 U	0.010 U
Total Suspended Solids	13.0	10.0 U	36.0	24.0
Total Toxic Organics	No constituents from the Total Toxics Organics list (40 CFR) were detected.			

TABLE 5-2
Analytical Results from Wastewater Discharge Samples
10/28/96 Sampling/Discharge Event

Analyte	Concentration, mg/L			
	Sample Designation			
	L05001	L05002	L05003	L050B4
Cadmium	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Chromium	0.005 U	0.005 U	0.005 U	0.005 U
Copper	0.020	0.020	0.020	0.019
Lead	0.003 U	0.003 U	0.003 U	0.003 U
Nickel	0.025	0.026	0.027	0.025
Silver	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Zinc	0.0230	0.0350	0.0200 U	0.0200 U
Total Cyanide	0.010 U	0.010 U	0.010 U	0.010 U
Total Suspended Solids	19.2	14.6	15.4	16.0

TABLE 5-3
Analytical Results from Wastewater Discharge Samples
12/09/96 Sampling/Discharge Event

Analyte	Concentration, mg/L			
	Sample Designation			
	L05005	L05006	L05007	L05008
Cadmium	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Chromium	0.005 U	0.005 U	0.005 U	0.005 U
Copper	0.014	0.014	0.014	0.014
Lead	0.003 U	0.003 U	0.003 U	0.003 U
Nickel	0.024	0.024	0.024	0.024
Silver	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Zinc	0.0200 U	0.0200 U	0.0200 U	0.0200 U
Total Cyanide	0.010 U	0.010 U	0.010 U	0.010 U
Total Suspended Solids	10.0 U	10.0 U	10.0 U	10.0 U

Prior to demobilization from the site, confirmation sampling of Lagoon 5 was conducted to confirm that deposition of sediment from rainwater discharged into the pond did not result in constituent concentrations exceeding site clean-up levels. This sampling event and the results are presented in Section 6.3, Lagoon 5 confirmation sampling.

6.0 REMOVAL CONFIRMATION SAMPLING

As sludge removal from Lagoons 4 and 6 was completed, confirmation sampling of floors and sidewalls of the excavated lagoons was conducted in accordance with the June 1995 RAP. Confirmation samples along the floor of the excavated lagoons were collected at the nodes of 70' X 70' grids. Samples along the sidewalls were collected from mid-depth every 50' around the lagoon periphery. Confirmation samples were analyzed for total cadmium, total chromium and TPH.

6.1 Lagoon 4 Confirmation Sampling

Early into operations (August 16, 1996), ENSR collected two preliminary floor confirmation samples from the northeast and northwest corners of Lagoon 4 in order to verify that the total depth of sludge was being removed. A sidewall sample was also collected from the west corner of Lagoon 4 to determine if enough sludge was being scraped from the sides. Results indicated that clean bottom had been attained, but that more material from the sidewall would need to be removed. Table 6-1 presents the results of these preliminary confirmation samples.

TABLE 6-1
Lagoon 4 Preliminary Sludge Removal Confirmation Samples
(collected from northeast and northwest corners)

Sample Designation	Date Collected	Total Concentration, mg/kg		
		Cd	Cr	TPH
L04SCF0100 ¹	08/16/96	1.0 U	9.5	1.0 U
L04SCF0200 ¹		37.5	43.6	10.1
L04SSW0100 ²		119	178	19.2

U - Not detected; preceding number is report limit.

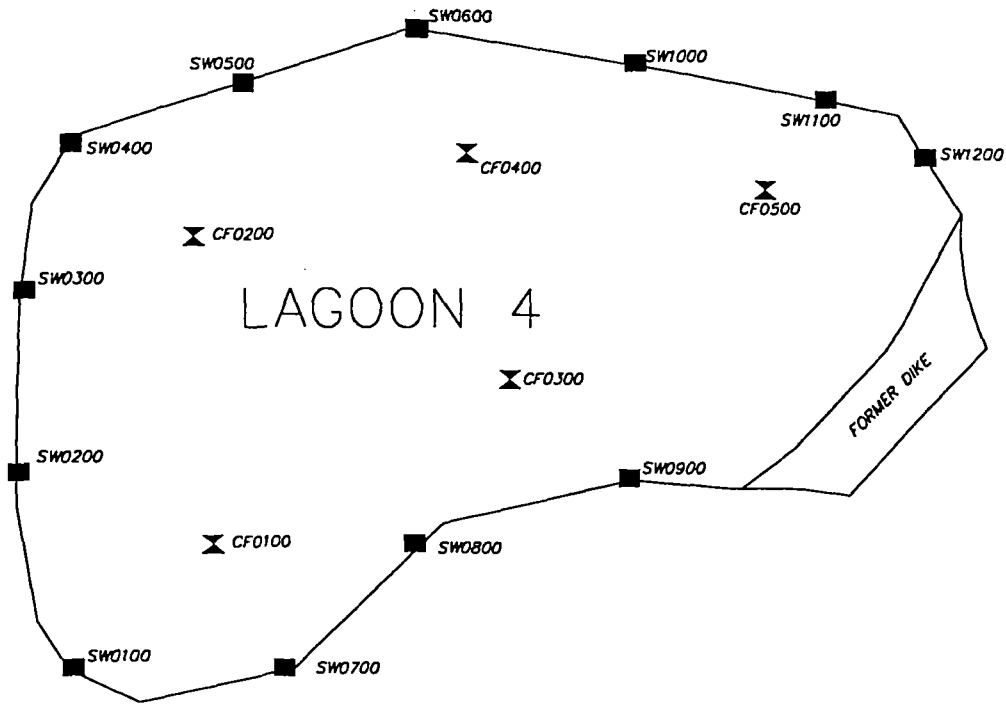
1 - L04SCF0100 and L04SCF0200 were collected from the floor of the northeast and northwest corners of the lagoon.



2 - L04SSW0100 was collected from the sidewall of the northwest corner. The final sidewall confirmation sample L04SSW0100 (10/16/96) was collected from the same location (See Table 6-2, Lagoon 4 Sludge Removal Confirmation Samples).

As sludge removal from Lagoon 4 was completed, final confirmation sampling of floors and sidewalls was conducted. Final confirmation sample results indicated that former Lagoon 4 had been excavated to below clean-up levels. Analytical results are presented in Table 6-2; Figure 6-1 shows the locations of the Lagoon 4 final confirmation sampling. Analytical data is provided in Appendix A of this report.

TABLE 6-2
Lagoon 4 Sludge Removal Confirmation Samples

Sample Designation	Date Collected	Total Concentration, mg/kg		
		Cd	Cr	TPH
L04SSW0100	10/16/96	5.6	15.4	1.0 U
L04SSW0200	11/12/96	7.9	19.7	49.2
L04SSW0300		7.3	18.8	55.7
L04SSW0400		8.5	20.7	47.7
L04SSW0500		5.9	14.8	49.5
L04SSW0600		9.8	22.8	4.1
L04SSW0700		8.9	20.3	99.1
L04SSW0800		7.2	19.1	76.4
L04SCF0100		1.0 U	10.8	1.0 U
L04SCF0200		1.0 U	9.3	1.0 U
L04SCF0300		11/26/96	1.0 U	10.7
L04SCF0400	10.7		16.7	10.0
L04SCF0500	1.0 U		8.9	1.0 U
L04SSW0900	2.6		12.4	8.8
L04SSW1000	19.2		38.5	1.5
L04SSW1100	1.0 U		9.1	1.0 U
L04SSW1200	8.7		22.5	1.0 U
U - Not detected; preceding number is report limit.				



-  SAMPLE LOCATION OF FLOOR OF LAGOON
-  SAMPLE LOCATION IN THE SIDE WALL OF LAGOON



SCALE IN FEET
1" = 60'-0"

ENSR

FIGURE 6-1
Confirmation Sample Locations

Lagoon No. 4
United Technologies Auto.
Memphis, Tennessee

DRAWN: JDF	DATE: 5/22/96	PROJECT NO. 6916-140-100	REV.
FILE NO. 6916140q	CHK BY: RM		

6.2 Lagoon 6 Confirmation Sampling

ENSR removed and consolidated sludge from the northwest corner of Lagoon 6 in order to create a storage space for treated sludge pending Tennessee approval of off-site disposal. ENSR collected confirmation samples (August 28, 1996) from the floor and sidewalls of Lagoon 6 to ensure that clean bottom was reached. Results confirmed that clean bottom had been reached.

As sludge removal was completed from Lagoon 6, final confirmation samples were collected, including a second sample collected from the floor of the northwest corner where treated sludge had been stored pending transportation and disposal. Table 6-3 presents the results of the confirmation sampling. Figure 6-2 shows the sample locations. Analytical data is presented in Appendix A.

TABLE 6-3
Lagoon 6 Sludge Removal Confirmation Samples

Sample Designation	Date Collected	Total Concentration, mg/kg		
		Cd	Cr	TPH
L06SSW0100	8/28/96	11.7	16.3	3.6
L06SSW0200		1.6	8.4	1.0 U
L06SSW0300		1.0 U	85.5	1.0 U
L06SCF0100		56.9	37.8	10.7
L06SSW0400	9/16/96	1.0 U	10.00	10.0 U
L06SSW0500		1.4	12.2	10.0 U
L06SSW0600		1.6	10.1	10.0 U
L06SSW0700	12/14/96	6.21	28.5	23.7
L06SSW0800		33.3	65.7	20.2
L06SSW0900		2.39	15.5	39.7
L06SSW1000		54.3	34.9	21.6
L06SSW1100		8.32	14.7	3.9

TABLE 6-3
Lagoon 6 Sludge Removal Confirmation Samples (Contin. . .)

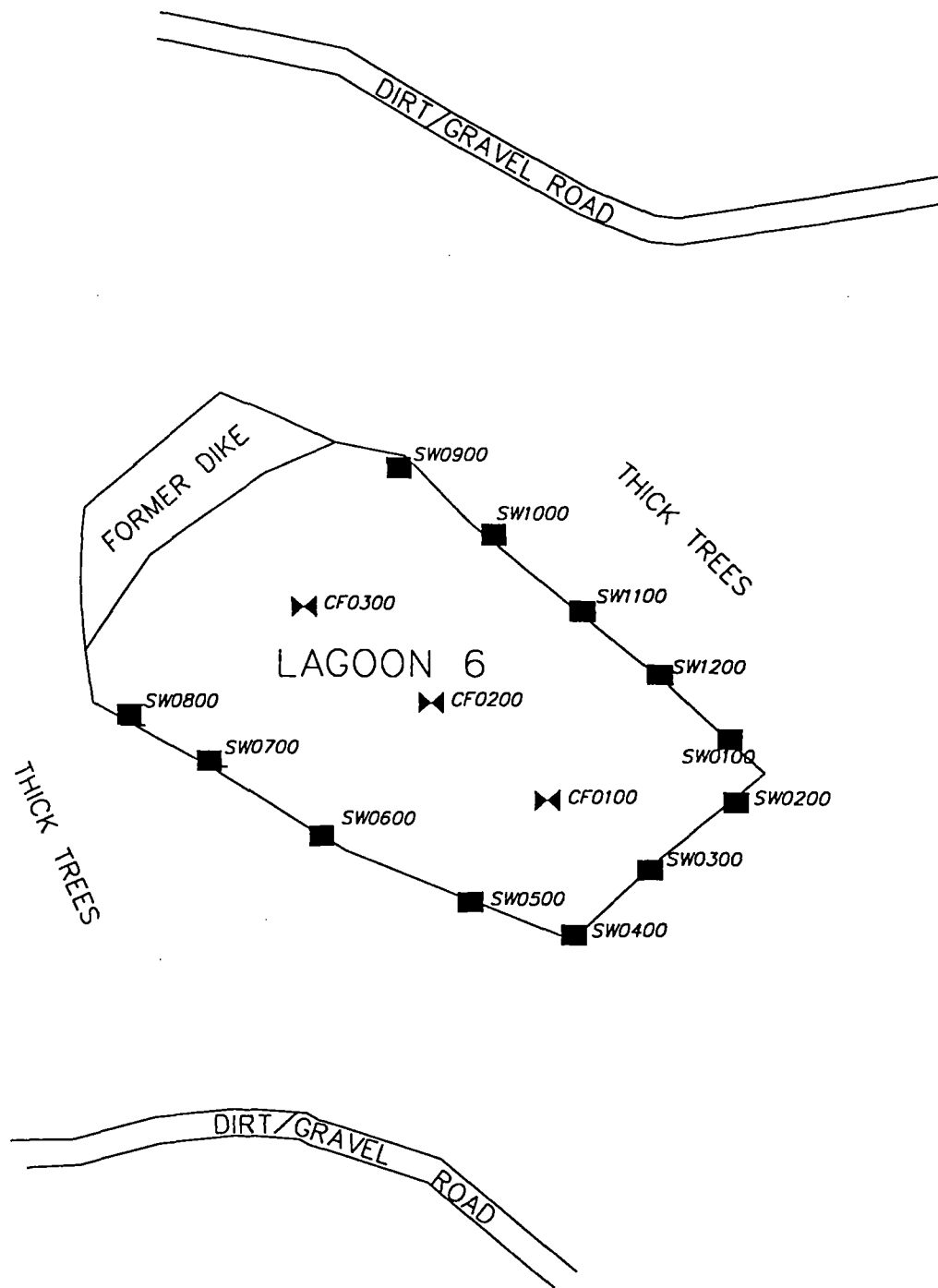
Sample Designation	Date Collected	Total Concentration, mg/kg		
		Cd	Cr	TPH
L06SSW1200	12/14/96	13.1	21.2	19.1
L06SCFA100 ¹		1.79	15.9	1.0 U
L06SCF0200		0.98 U	11.8	1.0 U
L06SCF0300		1.01 U	14.3	1.0 U
U - Not detected; preceding number is report limit.				
1 - Sample collected from same location as L06SCF0100 upon removal of temporarily stored treated sludge.				

6.3 Lagoon 5 Confirmation Sampling

Confirmation sampling of Lagoon 5 was conducted to confirm that deposition of sediment from rainwater discharged into the pond did not result in constituent concentrations exceeding site clean-up levels. In accordance with the Supplemental RAP, one floor sample was collected from the inlet, and three floor samples were collected from locations 50 feet radially outward at approximate 30° angles (since deposition of sediment decreases with horizontal distance, the concentration of any deposited contaminants would be highest at the pond inlet, decreasing with distance from the inlet).

Samples were collected on December 17, 1996. ENSR obtained approval from the acting OSC (Mr. John Nolen) to collect the samples from underneath the accumulated water in former Lagoon 5. It was decided that if results showed the pond bottom to be below clean-up levels, the currently accumulated water would not be discharged to the POTW (since the former lagoon was intended to remain a permanent stormwater retention pond). Samples were collected using a PVC pipe (covered at the top to displace water upon entrance into the pond). The pipe was plunged into the sample location and allowed to fill with a core of clay. The pipe was then lifted out of the pond, and a smaller pipe was used to push the soil/sediment out for a sample.

Results indicated that the lagoon had not been contaminated by deposition of sediment from stormwater, so the accumulated water was left in place upon demobilization from the site. Table 6-4 presents the results. Figure 6-3 shows the sample locations. Analytical data sheets are contained in Appendix A.



- ✕ SAMPLE LOCATION IN THE BOTTOM OF LAGOON
 ■ SAMPLE LOCATION IN THE SIDE WALL OF LAGOON



SCALE IN FEET
1" = 60'-0"

ENSR

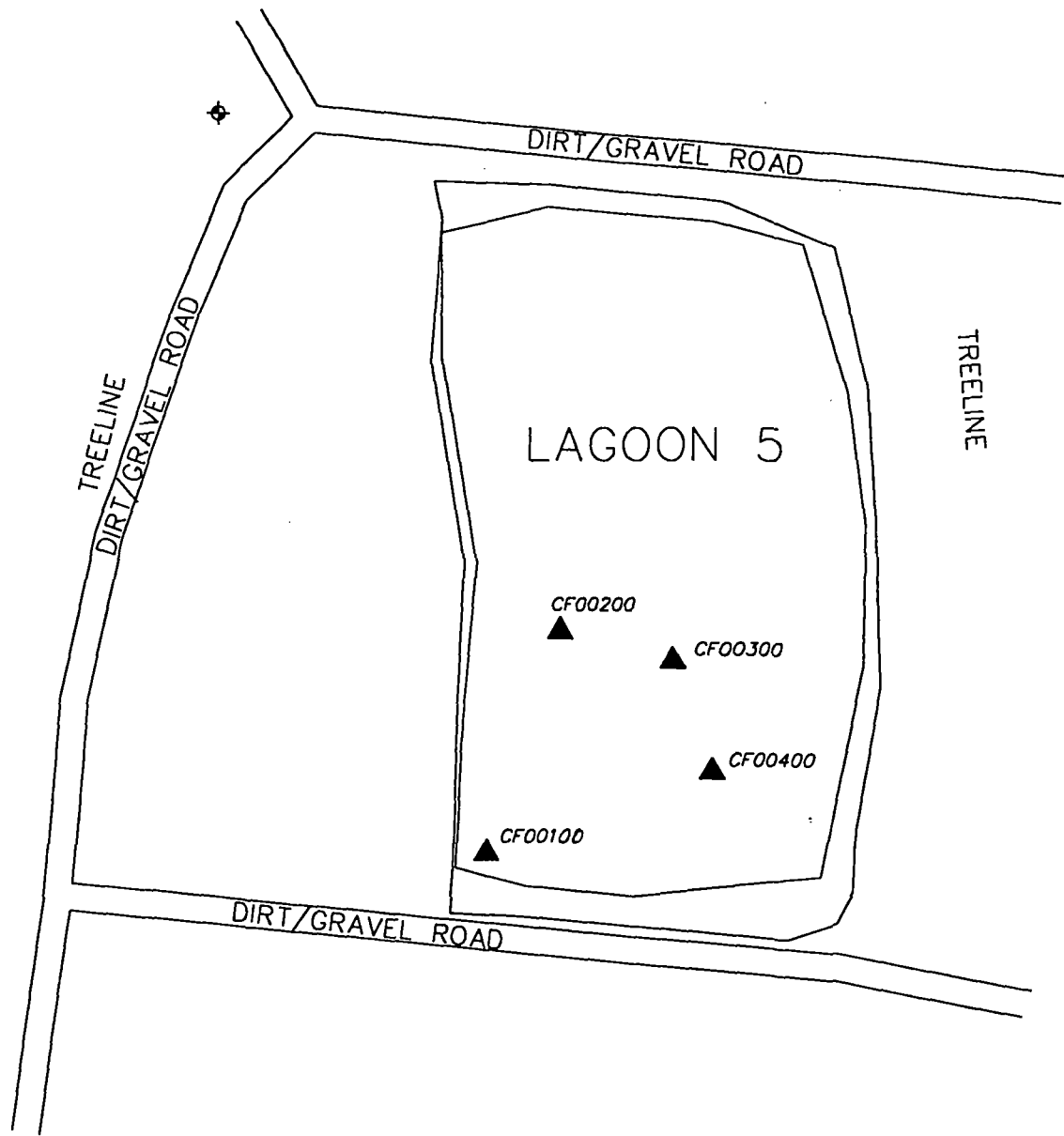
FIGURE 6-2
Confirmation Sample Locations

Lagoon No. 6
United Technologies Auto.
Memphis, Tennessee

DRAWN: JDF	DATE: 5/22/96	PROJECT NO. 6916-140-100	REV.
FILE NO. 6916140r	CHK BY: RM		

TABLE 6-4
Lagoon 5 Outfall Confirmation Samples

Sample Designation	Date Collected	Total Concentration, mg/kg		
		Cd	Cr	TPH
L05WCF0100	12/17/96	0.98 U	7.84	1.0 U
L05WCF0200		0.98 U	6.89	1.0 U
L05WCF0300		0.96 U	9.77	15.3
L05WCF0400		0.97 U	7.02	1.0 U
U - Not detected; preceding number is report limit.				



SCALE IN FEET
1" = 60'-0"

ENSR

FIGURE 6-3
Confirmation Samples From Outfall Location
Lagoon No. 5
United Technologies Auto.
Memphis, Tennessee

DRAWN: J.Ferranti	DATE: 5/22/98	PROJECT NO. 6916-140-100	REV.
FILE NO. 6916140?	CHK BY: RDM		

7.0 CONCLUSION

Based on the results of the verification sampling and removal confirmation sampling, all contamination associated with the lagoons has been removed from the site to below the clean-up levels established by the January 26, 1995 UAO, with the possible exception of small quantities of sludge around the natural gas pipeline. Any material left around the pipeline was covered by at least 2 feet of clean soil.

All impacted sludge was treated to below the final published delisting levels and transported to and disposed of at BFI's South Shelby Landfill.

Due to early delays resulting from the TDEC's delisting process and later delays caused by inclement weather, the deadline for the work to be conducted under the AOC between UTA and EPA was extended twice, with the final established deadline of December 31, 1996 (November 26, 1996 letter from EPA to UTA). UTA/ENSR has completed the work within the (revised) established timeframe.

The work conducted by UTA under the AOC, along with the previous work conducted by UTA under the UAO concludes UTA's part of the Removal Action at Highway 61 Industrial Site in Memphis, Tennessee. This report and its accompanying documentation, along with the UAO Final Report to be submitted by EnSafe, and all previously submitted reports incorporated into the final reports by reference, are intended to summarize and provide all final documentation of the work conducted by UTA as part of the Removal Action.

8.0 COST ESTIMATE

The estimated total cost of the work conducted under the AOC, including work plans, agency correspondence, labor and equipment, analytical costs and disposal costs is \$1.63 million.